A Summary: The 8th US Climate Modeling Summit (USCMS) and Workshop (02-04 August 2022)

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Background on USCMS and Workshop

The USGCRP's IGIM has been convening an annual USCMS since 2015 to improve the coordination and communication of national climate modeling goals and objectives. These objectives include:

- Developing a shared understanding of modeling groups' directions and implementation strategies;
- Identifying opportunities for enhanced coordination and synergy among modeling groups; and
- Identifying outreach opportunities to user communities.

The Summits bring together representatives from the US climate model development centers and from operational climate and weather prediction programs:

- NOAA Geophysical Fluid Dynamics Laboratory (GFDL CM/ESM);
- NOAA NWS/NCEP (GFS);
- NASA Goddard Institute for Space Studies (GISS ModelE);
- NASA Global Modeling and Assimilation Office (GMAO GEOS);
- NSF NCAR Community Earth System Model (CESM);
- DOE Energy Exascale Earth System Model (E3SM).

Background on USCMSs and Workshops

Starting in 2017, a topical workshop has also been organized under the auspices of the USCMS and in conjunction with the annual meeting.

These workshops serve as a venue to have focused technical communications on a high-priority modeling-related topic identified by the modeling centers together with the IGIM, and they include invitees from the broader community.

This year's Topical Workshop was on *Water Cycle and Water Security*.

USCMS Meeting Agenda

Part I: Updates from activities that started at previous USCMS meetings and Workshop summary;

Part II: Updates from the centers; and

Part III: Discussions on several ongoing efforts and emerging / future opportunities and challenges, focusing on possibilities for coordinated activities.

A concern raised by the modeling center participants was the rather sparse participation of the program managers both at the Topical Workshop and the Summit Meeting.

Summary of Projects Initiated at the Previous USCMSs

The *world-avoided* mini-Model Intercomparison Project (mini-MIP); lead Jean-Francois Lamarque (NCAR):

It aims to look at the impacts that the Clean Air Acts have had on air quality and climate, by developing appropriate emission scenarios.

An initial set of simulations have been performed by CESM2 (WACCM), DOE (E3SM), NASA GISS (modelE), and NOAA GFDL (ESM4).

The results show significant impacts of US emission trajectories on global surface ozone concentrations and particulate pollutions.

Further progress involving more detailed analysis of the simulations has not been realized due to lack of resources. With Lamarque's departure from NCAR, it is unlikely that this project will be completed.

Summary of Projects Initiated at the Previous USCMSs

Examining the Physical Realism of Aerosol-Induced Cloud Drying Across US Models; leads Johannes Mülmenstädt (PNNL) and Susanne Bauer (GISS):

The Project emerged from the 2020 USCMS Workshop on Aerosol – Cloud Interactions.

All six modeling centers have been participating in this project that combines observational data with model results and theoretical studies to better understand the physical realism of aerosol-induced cloud drying across models.

The project has been completed with two submitted manuscripts.

Summary of Projects Initiated at the Previous USCMSs

Is better representation of modes of variability related to reduced model biases and better simulations of extreme events in US climate models?; Gokhan Danabasoglu (NCAR):

The Project emerged from the 2021 USCMS Workshop on Predictability Limits Arising from Model and Prediction System Challenges.

A goal is to generate a large, multi-dimensional matrix of performance scores for Modes of Variability (MoVs), model biases, associated teleconnections, and representation of extremes for a set of US models, providing a summary assessment of the relationships between MoVs and other aspects of model performance with a focus on extremes.

In addition to routine analysis methods, machine learning tools will be an important element of the project to probe relationships.

A proposal was submitted to NASA at the end of August 2022.

Updates from Centers

In the second part, the six modeling centers provided updates on their science, priorities, challenges, and plans.

These presentations generally covered the centers' new model configurations, developments, frameworks, initiatives, and some results of interest, including those from CMIP6 simulations.

Discussion Topics

Future Outlooks on CMIP and IPCC: A suggestion is to focus on something like three main challenges and goals that would galvanize the community for inspired participation.

Update: Lamarque participated in the above discussion in his role as the chair of the CMIP Panel. Since the Summit Meeting, Lamarque has resigned from his NCAR position as well as from the CMIP Panel. Also considering V. Balaji's departure from GFDL, neither the CMIP Panel nor the Working Group on Coupled Modeling (WGCM) has any members from the US modeling centers who are actively involved with their coupled models.

Perspectives Manuscript on Next Generation Predictions and Projections: See Annarita's presentation

Discussion Topics

Climate Model Data Storage and Accessibility Challenges – NSF EarthCube Workshop: What about model data? A summary of the Workshop held in Grand Forks, ND during 25-27 July 2022.

Climate Process Teams: CPTs continue to be an extremely valuable mechanism for efficiently and quickly translating the latest science into improved model parameterizations, establishing a common language, and reconciling disagreements across observations, theory, and modeling communities.

Action item: Solicit both the modeling centers and the IGIM on their priorities for future CPTs.

Discussion Topics

Ensemble Strategies and (Coupled) Data Assimilation in Earth System Modeling and Predictions: The participants were updated on the ever-growing scope and applications of climate model ensembles; the increasing scope of Earth system processes, including land surface, soil, ecosystems, and ocean biogeochemistry, being considered for different applications; and the suite of data assimilation technologies being applied.

Global Precipitation Experiment (GPEX): Jin Huang from the NOAA CPO provided an introduction to GPEX as well as an update on the status of a related white paper.

Discussion Topics

CERESMIP: A discussion was held on a possible new Model Intercomparison Project (MIP) among the centers focused on understanding the trends in the satellite observations by Clouds and the Earth's Radiant Energy System Energy Balance and Filled (CERES EBAF) since 2003.

The proposed MIP – referred to as CERESMIP – would be mainly AMIP-style runs, using updated forcings from 2000 through 2021, which would allow us to explore to what extent the shortwave trends in CERES data can be explained as either cloud feedbacks to greenhouse gas changes, internal variability, aerosol forcings, indirect effects, or a combination of these.

The modeling centers expressed enthusiastic interest in this project.

Action item: Ramaswamy, Bauer, Pawson, and Gavin Schmidt were tasked with coming up with a detailed draft CERESMIP protocol that can be circulated among the modeling centers as a first step.

Discussion Topics

Miscellaneous Updates: Gary Geernaert provided updates on several topics of interest to the modeling centers, conveying information on various high-level ongoing and planned activities at government agencies and climate-related committees.

Topics covered included machine-learning, wildfires, (solar) geoengineering, mountain hydrology, clean energy, tipping points, coastal science, and urban-related research.

Plans for the 9th USCMS

For the 2023 meeting (the 9th USCMS), the group agreed that Ruby Leung (PNNL) and John Dunne (GFDL) (??) would co-chair the meeting.

The meeting is anticipated to be a hybrid event with its location TBD.

An expressed desire is to have the meeting earlier in the year, perhaps in early Spring, returning to the timeline of the earlier USCMS meetings.

The topic of next year's workshop will be on *oceans' role on air – sea coupled climate interactions*.

Thank You!